# Simulation Evidence on the Properties of Alternative Measures of Working Capital Accruals: New evidence from the UK

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**Abstract**

Accounting information quality is fundamental to various stakeholders including investors and standard-setters. Given the multi-dimensionality of accounting information, the existing literature has pre-dominantly relied on an approach based on the modified DD model – a model first proposed by Dechow and Dichev (2002) and modified by Bushman *et al* (2011), to examine accounting information quality. This paper assesses the specification and explanatory powers of the DD and modified DD models by empirically examining data on UK listed firms over the period 2000-2013. Using panel regression methods, we examine accruals quality based on firm-specific regressions of working capital accruals on one-period lagged, current, and one-period lead cash flows from operations. We find that adding additional explanatory variables on firm characteristics add additional explanatory power to the DD model to the extent to which accruals map into cash flow insights based on the UK data. This study empirically well fits with the internal workings of cash flows. As investors fixate only on accounting earnings, they may fail to reflect fully on information contained in cash flow components and working capital accruals of current and future earnings.

*Key words: Cash Flow, Modified DD model, Working Capital Accruals*

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## 1. Introduction

The quality of accounting earnings information plays a crucial role in the usefulness of earnings information. It is an important and interesting topic for researchers, given that the efficient and reliable working of stock markets is dependent on the quality of accounting information. In this backdrop, this paper aims to examine the empirical validity of accounting quality measures motivated from the Dechow and Dichev (2002) accruals model (hereafter, DD model) and as modified by Bushman *et al* (2011) (hereafter, MDD model). Since the quality of accounting information is an important factor in decisions made by financial analysts, investors and other users, the empirical literature has primarily focused on the established DD and MDD models as a proxy for firm's accruals, earnings and overall accounting information quality. Many researches on accounting information have used quality measures emanating from the above models to investigate numerous economic hypotheses, for e.g, Olsson and Schipper (2005), Ecker *et al* (2006), among others, examine the association between accounting information quality and cost of capital; Raman *et al* (2013) consider the association between accounting information quality and investment efficiency; Izadi Zadeh Darjezi (2016) investigates the association of accounting information quality with that of firm size and volatility of sales, cash flows, accruals and earnings. The Jones (1991) model describes the working capital accruals and depreciation process as a function of growth in sales and property, and, plant and equipment (PPE) during a period. However, the explanatory power of the Jones model is substantially low – it explains only about ten per cent of the variation in accruals. The low explanatory power of the Jones model indicates that managers have substantial discretion through the accrual process, given that they try to mask fundamental performance. Some studies (for e.g., Xie, 2001, among others) show that the residuals value from the Jones model in comparison with non-discretionary accruals have lower predictive ability to predict one-period lead earnings accruals. Dechow *et al* (1995) find that the residuals are negatively correlated with cash flow. On the contrary, Dechow *et al* (2003) show that the residuals value are positively and significantly correlated with total accruals and earnings performance. The ensuing literature demonstrates that the discretionary accruals are normally less powerful than total accruals at detecting earnings management (see, Dechow *et al*, 2010). Holthausen *et al* (1995) and Kothari *et al* (2005) add the return on assets (ROA) to the model to control for the normal level of accruals and generate 'performance-matched' residuals. They argue that the proxy of normal accruals for the generation of residuals explain only a meagre ten to twelve percent of the variation in accruals. Their model is expected to improve the measure of discretionary accruals. Also, 'performance-matched' residuals approach is useful when the correlation between performance and residuals is a significant concern.

In 2002, Dechow and Dichev used a new proxy to find a matching function of accruals to cash flows. According to their model, accruals are defined as a function of current, past, and future cash flows from operations. They suggest the use of operating cash flows in the model because accruals reflect the anticipation of future cash in/out flow from operations and conversely, when cash previously recognised in accruals is received or paid. It is to be noted that their model focuses on short-term working capital accruals rather than on long-term accruals. Their regression analysis shows that the R-squared at the firm level, industry level and the pooled level are 47, 34, and 29 per cent respectively, which, in comparison to the modified Jones model, are an improvement. They use the standard deviation of the residuals in their model as a proxy to capture firms' earnings quality. They show that, on one hand, firms with larger standard deviations in residuals have less persistent earnings; while, on the other hand, firms with larger standard deviations in residuals have larger accruals, more volatile cash flows and longer operating cycle accruals and earnings. Their findings indicate that such firm characteristics point towards a greater possibility of estimation error in accruals. The ensuing literature, in an attempt to improve the original DD model, has included a range of additional explanatory variables, such as growth in revenue and depreciation in PPE (see, for example, McNichols (2002) and Francis *et al* (2005), among others). Bushman *et al* (2011) modified the DD model by decomposing the accruals into good accruals and accrual estimation error. It follows that accrual accounting involves the anticipation of future economic benefits (e.g., cash inflows) as well as costs (e.g., cash outflows) (Allen *et al*, 2013)[4]. Bushman *et al* (2011) therefore include the two drivers of good accruals (firm growth and temporary fluctuations in working capital) as a strategy for their model section. Allen *et al* (2013) use variables on contemporaneous sales and employee growth to capture accruals related to growth in the working capital accrual. They too decompose firm-level working capital accruals into 'good accruals' and accrual estimation error. Their finding shows that the good accruals correctly anticipate future benefits, although accrual estimation errors do not. They highlight that the definition of 'good accruals' and accrual estimation errors differ from that of the standard definitions of 'normal' and 'abnormal' accruals as recognised in the Jones model. They emphasise that their definition of accruals include an *ex post* evaluation to show that an accrual correctly anticipates a future benefit in contrast to the standard definition which contains an *ex ante* evaluation of management intent at the period of making the accrual. With regards to the recent debate on using the traditional model (DD model) or modified model (MDD model), this paper examines the specification of the accruals model to assess the explanatory power and reliability of the two models to evaluate accruals quality. In this paper, the standard deviation of the residuals is used to measure accrual quality in both the DD as well as the MDD model to find the quality of working capital accruals that result from our firm-specific regressions of working capital accruals on last, current and one-year-ahead cash from operation.

[4] Allen et al (2013) argue that the financial effects of transactions are to be recognised when they become probable rather than when the cash concerns are realised. Intrinsically, accruals reverse when the cash flows that they anticipate are realised. So, we can refer to such accruals as 'good' accruals.

## 2. Literature Review and Model Development

The main objective of most studies on earnings quality is to examine financial features linked with the persistence of earnings. However, these studies are limited in that they only consider proxies for earnings quality in their evaluation of earnings persistence. This emphasises the importance of accruals quality in accounting and financial economics. Accruals as an overall measure of earnings quality have widely been used in the accounting literature. For example, accruals have been used to create the largest spread in entire excess returns (Perotti and Wagenhofer, 2014). Further, Shi and Zhang (2011) highlight the differences between using two methods of measuring accruals, using changes in the financial position items as well as accruals that are calculated as earnings minus cash from operating activities, in terms of effects on accrual strategy returns. Also, Cheng *et al* (2013) show that the earnings quality based on the role of earnings and operating cash flows can affect a firm's valuation. They show that operating cash flows explain contemporaneous abnormal returns well when the earnings quality is better. Hao (2009) shows that the firms with longer operating cycle has a higher tendency of mispricing accruals as per the market efficiency test thus indicating investors fixation on earnings rather than on the persistence of accruals.

A substantial part of accounting research is centred on accruals quality as indicated by a growing interest in modelling the accruals process within the accounting literature. Following Dechow *et al* (2010), the accruals literature has primarily considered three broad categories of models on accruals. The first category includes models that have been developed based on the Jones (1991) model, which explains working capital accruals as a function of growth in contemporaneous sales and PPE. The second category of accruals models are based on the work of Dechow *et al* (1995) that modify the Jones model to adjust for growth in credit sales and by matching with firms of similar performance (Kothari *et al*, 2005).

In the third category, the category that this paper further explores, unlike the Jones model, Dechow and Dichev (2002) suggests an accruals model (DD model) that leverage on the matching function of accruals. The DD model demonstrates a fundamental role of accruals, the purpose of which is to reflect the timing difference between economic benefits and cash flows realisation. In this model, accruals are measured by estimation errors from regressions of working capital accruals on past, present, and future cash flows. In comparison with the Jones model, the DD model does not need any assumption on normal accruals process. Nevertheless, this model suffers from the error-in-variables problem for the reason that past, present, and future cash flow components as considered in the working capital accruals model are not directly observable in financial statements.

Dechow and Dichev (2002) suggest a measure of accrual quality which has been widely used in the accounting literature to capture accrual estimation errors and accruals quality (see, for example, Ashbaugh *et al* (2006) , Bharath *et al* (2011) , Francis *et al* (2005), Myers *et al* (2003), Doyle *et al* (2007), and Perotti and Wagenhofer (2014), among others). Their model employs a firm-specific regression with working capital accruals as the dependent variable and uses cash flows from operating activities as the explanatory variables. From an empirical viewpoint, revenue is related to accruals as change in accounts receivables minus change in current deferred revenue, and similarly, expense is related to accruals as the difference between revenue related accruals and total working capital accruals. Therefore, cash outflows are defined as the difference between cash inflows and net operating cash flows. It is also possible that a firm may first receive payments and then pay for expenses incurred. In other words, cash inflows allow for revenue recognition whereas cash outflows lack expense recognition. However, the focus of this study is not on the assumptions to allow for different cash representing schedules for revenue and expenses related accruals.

Additionally, the DD model provides new evidence that the market is more concerned about earnings, thus emphasising the importance of contextual analysis of financial statement. Finally, it corroborates Xie (2001) that estimation errors in accruals drive the lower persistence of accruals. This study focuses on both the DD model as well as the MDD model to examine which of them can more accurately capture total working capital accrual estimation error and accrual quality. As in the original models, we operate under the assumption that residuals from the DD and MDD models reflect properties that are more consistent with the behaviour of accruals estimation errors. Therefore, in this paper we aim to compare the results from both DD and MDD models to find which one of them is more effective in explaining working capital accruals using firm level data from the UK.

Estimation errors in working capital accruals, by nature, must reverse in full in the DD model, which is simple and intuitive. They define the elements of working capital accruals in period *t* as:

$$Wcc_t = CF_{t-1}^{t} - (CF_t^{t+1} + CF_t^{t-1}) + CF_{t+1}^{t} + \varepsilon_{t+1}^{t} - \varepsilon_t^{t-1} \qquad (1)$$

where, $Wcc_t$ is the current or working capital accruals in period *t*; *CF* is the net cash flow from receipts or disbursements, where the subscript refers to the period the cash flow is received or disbursed, and the superscript refers to the period it is recognised in income (Dechow and Dichev, 2002); and, $\varepsilon_{t+1}{}^{t}$ and $\varepsilon_t{}^{t-1}$ are changes for estimation errors and their corrections. If all cash flow components are observable, then we can estimate the following times-series equation[5]:

$$Wcc_t = \beta_0 + \beta_1 CFO_{t-1} + \beta_2 CFO_t + \beta_3 CFO_{t+1} + \varepsilon_t \qquad (2)$$

In equation 2, consistent with the DD model, working capital accruals ($Wcc_t$) are regressed on one-period lagged, current and one-period lead cash flows from operations (CFO). The error term in the regression reflect the accruals that are unrelated to cash flow realisations and the dispersion (as captured by standard deviation) of the error term is a firm-level measure of accrual quality. Higher dispersion of errors represents lower quality of accruals.

[5] Following Dechow and Dichev (2002), we use the measure of accruals as changes in working capital accruals where the *Wcct* *is* Working Capital Accruals = [accounts receivables (AR) + Inventory (Invt) + Other current assets (OCA) – accounts payable (AP) – income tax payable (ITax) – Other current liabilities (OCL)] /average total assets (TA); CFO is the Cash Flow from Operations and calculated as follows: CFO= [Net cash flow from operating activities (CFO) - Extraordinary items and discontinued operations (Ex)] / average total assets (TA).

Wysocki (2008) examines the theoretical foundations of the DD regression model of working capital accruals. He notes important limitations of the empirical model and shows that the DD model is unable to differentiate between high quality accruals, opportunistic discretionary accruals and measurement error. He demonstrates that the DD model's main emphasis is to distinguish estimation errors in accruals[6]. Thus, if there are no estimation and measurement errors, then the estimated coefficients, $\beta_1$ and $\beta_3$, in equation (2) should be equal to unity (i.e. +1) and the estimated coefficient, $\beta_2$ should be equal to negative unity (i.e. -1). Also, the $R^2$ for the estimated equation should be 1 and consequently, the residual variance should be zero.

Moreover, he highlights that equation (2) can be seen as a model of non-discretionary accruals, which is driven by exogenously classified cash flows from transactions. According to his discussion, if the categorisation of the cash flows from transactions is exogenous, then we can consider the unexplained part of working or current capital accruals in period *t* to be related to either estimation errors, or discretionary accrual choices, or even both. Further, studies such as Francis *et al* (2005) argue that the measurement error problem in this model decreases its ability to properly classify firms' accounting quality. Moreover, they highlight that the measurement error can be correlated with other firm features such as firm risk.

The subsequent literature has attempted to modify the DD model in several ways. The most noted work has been undertaken by Bushman *et al* (2011), which has been used by Allen *et al* (2013) to decompose working capital accruals, based on firm-level data, into 'good accruals' and 'accrual estimation error'[7]. They define 'good accruals' as accruals that correctly anticipate future benefits, which are driven by two factors: first, by accruals related to growth in the working capital base required to support changes in the firm's scale of operations, and, second, by accruals related to temporary fluctuations in a firm's working capital requirements (Allen *et al*, 2013). The unexplained variation in the accruals (i.e. residuals in the model) model is termed as 'accrual estimation error'. They highlight that previous studies (such as, Defond and Park, 2001, Baber *et al* , 2011, among others) based on Jones (1991) accruals model, which decompose accruals in to 'normal' and 'abnormal' components, fail to capture accruals related to temporary fluctuations in working capital unlike their model. This is mainly due to their definition being based on an *ex post* assessment of whether an accrual correctly anticipates a future benefit. This implies that it is not necessary for accrual estimation error to involve intentional earnings management, as it may instead arise from the absence of foresight or lack of conservative accounting established under generally accepted accounting principles (Allen *et al*, 2013). We adopt this model due to Bushman *et al* (2011) and Allen *et al* (2013), in this paper, as specified below:

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[6] Wysocki (2008) argues, according to the DD model framework, higher accruals quality arises from a lower residual variance. This implies that a higher coefficient of determination for the regression ($R^2$) will imply a better quality of accruals.

[7] A similar model is proposed in McNichols (2002). See, Allen et al (2013), for a description of differences in their model from that of McNichols (2002).

$$Wcc_t = \beta_0 + \beta_1 SG_t + \beta_2 Gem_t + \beta_3 CFO_{t-1} + \beta_4 CFO_t + \beta_5 CFO_{t+1} + \varepsilon_t \qquad (3)$$

where, $SG_t$ is the growth in sales [($Sales_t$−$Sales_{t-1}$)/$Sales_{t-1}$ ] and $Gem_t$ is the growth in employment [($Employees_t$−$Employees_{t-1}$)/$Employees_{t-1}$]. In equation *(3)*, sales and employment growth are included to explain accruals associated to growth in the working capital base needed to help firms cope with changes in their operations. The cash flow variables in equation (3) are included to capture accruals associated with temporary fluctuations in a firm's working capital. This model makes use of information that would not have been possibly available to managers of firms or to investors at the time when the accrual was made. As such, both managers and investors are unable to incorporate all of this information into accruals and stock prices at the same time. Given this, if a systematic relation between accruals at time *t* and cash flows at time *t+1* is found, then it would imply that the associated accruals are 'good accruals' for which management correctly anticipated future benefits, as emphasised by Allen *et al* (2013).

Given the preceding discussion, in this paper, we compare the explanatory power of the DD and MDD models in order to assess the importance of modelling both components of 'good accruals' by decomposing them into accruals associated with firm growth and accruals related to temporary fluctuations in working capital.

## 3 Data, Sample Selection and Descriptive Statistics

The data sample of UK firms that we use in this paper is suitable to examine the specification and explanatory power of accruals models based on the DD and MDD models described in the preceding section. Relevant firm level financial data on UK firms has been collected from Worldscope database via Thomson One Banker. Our raw sample comprises of all companies listed on the UK market. The variables that we consider for the analysis, along with their definitions are listed in Table 1. We consider all variables at the end of April each year from 2000 to 2013. Following previous literature, we assume that there is a four-month delay between the end of a firm's fiscal year and when the accounting information becomes publicly known. All firms with available data are included in our initial raw sample, regardless of their fiscal year-ends. We winsorize 1 percent of the extreme values of variables in our sample. After excluding firms with nonstandard reporting periods and firms with missing data from our raw sample, we are left with 9,004 firm-year observations. Then, we removed the financial firms from our sample, which resulted in a further decline in observation to 8,369 firm-year observations. The remaining firm-year observations are adjusted for lags and leads, which leaves us with 5,207 firm-year observations, which is our final sample for the following analysis. It is to be noted that our interest is in the firm's operating performance, and hence our focus is on profitability before interest and taxes.

Table 1 presents the descriptive statistics of the variables used in the regression analysis and Table 2 presents the cross-correlations between the variables. An inspection of both the tables shows that descriptive statistics are in line with prior researches and it is consistent with those of other studies using similar variables such as Barth *et al* . (2001) and mainly with Dechow and Dichev (2002). The mean of earnings between 2000 and 2013 exceed cash flows from operating activities, and working capitals (*ACC*) are positive. This is in line with *a priori* expectations as when firms grow, consequently their working capital will also increase. Dechow and Dichev (2002) highlight that average accruals are negative (-0.046) and our result in Table 1 is consistent with theirs (-0.047). The negative mean and median for accruals reflect that aggregate accruals include depreciation and amortization. Further, the means and medians of cash flow from operating activities (*CFO*) as well as earnings before long-term accruals (*Earn*) are positive, which are also in line with Dechow and Dichev (2002).

From Table 2, which presents both Spearman and Pearson correlation coefficients with significance levels, we conclude that the cross-correlation between the variables in our sample is comparable with previous research. The Spearman and Pearson correlations are similar in magnitude and sign for all the variables. Specifically, we note that there is a positive correlation between *Earn* and *CFO* (0.74), and between *Earn* and *ACC* (0.33), and a negative correlation between *CFO* and *ACC* (-0.382), as expected *a priori*. Given that changes in working capital accruals capture variation in total accruals, we find that *Accruals* and *ACC* are positively correlated. Table 2 also indicates that there is significant autocorrelation in *CFO*, *Accruals* and *Earn*. Also, our result demonstrates that changes in working capital accruals and earnings may predict future cash flows from operation which is in line to prior studies such as Dechow and Dichev (2002) and Allen *et al* (2013).

## 4. Regression results and findings

The panel least squares regression results for both the DD and MDD models are presented in Table 3, Panel A. As mentioned earlier, in both the models, the regression results reflect the accruals that are distinct to cash flow realisations. Moreover, standard deviation of the residuals from the estimated models demonstrates a firm-level measure of accrual quality.[8] A greater standard deviation represents lower quality of accruals and vice versa. Our results are consistent with previous literature in that variation in working capital accruals in the current period are negatively and statistically significantly associated to the current cash flow from operations. The coefficient on contemporaneous *CFO* for the DD model is negative and statistically significant (-0.489, t-statistic = -41.890, p-value <0.001). Similarly, the coefficient on contemporaneous *CFO* for the MDD model is also negative and significant (-0.497, t-statistic = -42.750, p-value <0.001) as well. Correspondingly, working capital accruals are positively related to one-period lagged *CFO* for both DD and MDD models, the coefficients being 0.214 (t-statistic = 18.150, p-value <0.001), and,0.240(t-statistic = 19.990, p-value <0.001) respectively. Likewise, working capital accruals are positively associated to one-period lead *CFO* in the DD equation (coefficient being 0.153, t-statistic = 16.080, p-value <0.001) as well as in the MDD equation (coefficient being 0.138, t-statistic = 14.430, p-value <0.001). These findings are consistent with that

[8] See footnote 6.

of previous studies such as Dechow and Dichev (2002), and, Allen *et al* (2013). The most notable point of the results is that, in the MDD model, working capital accruals are positively and significantly associated to sales growth (*SG*). The coefficient on *SG* in the MDD model is 0.027 and is statistically significant at all conventional levels of significance. However, the coefficient on employee growth (*Gem*) is negative, but is not statistically significant. These results indicate that, while sales growth captures changes in working capital accruals, employee growth cannot explain variation in working capital accruals. The goodness of fit indicator for both the estimated DD and MDD models suggest that the models have reasonable explanatory power to explain variations in working capital accruals –the Adjusted $R^2$ for the DD equation is 0.253, and, for the MDD equation is 0.266. Based on these results, we conclude that MDD model has better explanatory power than the DD model, albeit the fact that the increase in the explanatory power is marginal.[9]

In Table 1, the estimations for the DD and MDD models were undertaken by pooling firm level data over the years 2000 to 2013. The underlying assumption behind pooling the sample is that the intercept and slope coefficients are constant across firms over time. As such the error term captures the effect of all those factors that vary across firms and over time on working capital accruals that have not been explicitly introduced in the models as explanatory variables. Therefore, the pooled regression model may distort the real image of the relationship between the working capital accruals as a dependent variable and cash flow from operations and other independent variables in the regression model as it fails to account for any potential firm specific time invariant factors. To overcome this, we re-estimate both the DD and MDD models using Fixed Effects and Random Effects estimators. Given that it is likely that the error term in both the models are correlated to the regressions, we expect *a priori* that the fixed effects estimators will be more suitable; but for the sake of completeness, we also undertake a formal test to choose between the fixed effects and random effects approach to estimation of both the models. The results are presented in Table 4. The overall findings are unchanged. The coefficients on past, present and future cash flows in the DD equation under both fixed effects and random effects models have same signs and similar magnitudes as that under the pooled least squares (Table 3), and they are all statistically significant. In the MDD equation, both the fixed effects and random effects estimators result in coefficients that have the same sign and similar magnitude to that of the coefficients obtained through the pooled least squares estimators in Table 3. Once again, we find that all the coefficients in the MDD model are statistically significant, except for the coefficient on employee growth. On using the fixed effects and random effects estimators, we note that the explanatory power of both the DD and MDD models, as reflected by their Adjusted-$R^2$, have increased; although the MDD model retains its position in being the better specification. Finally, the Hausman's test to choose

[9] In our regressions, we test for multicollinearity using the Variance Inflation Factor (VIF). We find that VIF for each of our variables in the regression equations is less than 4 (and the inverse of the VIF is greater than 0.25), thus concluding that there is no multicollinearity. These results are presented in Panel B of Table 3. Also, to overcome potential problems of biased standard errors in our regressions due to presence of heteroscedasticity, we use robust standard errors.

between fixed or random effects estimators indicate that the preferred estimator for both the DD (*$Chi^2=23.36$, $p<0.001$)* and MDD (*$Chi^2=39.85$, $p<0.001$)* models is the fixed effects estimator, as expected *a priori*. .

We also extend the analysis by estimating the DD and MDD models separately by broad sectors based on our sample. We present the pooled least squares results in Table 5 by splitting our sample over nine broad industrial sectors; Panel A reports the results for the DD model, and, Panel B reports the results for the MDD model. The choice of the nine broad industrial sectors was based on the Industrial Classification Benchmark (ICB) code from Thomson One Banker database (World scope).[10] Panel A in Table 5 shows that the coefficients on lagged, current and lead cash flows from operations are respectively positive, negative and positive for the DD model. The magnitude of the coefficients varies across sectors, but is statistically significant in all cases. Focusing on the coefficient on contemporaneous cash flows, we note that the telecommunications sector reflects highest effect of current cash flows on working capital accruals, while utilities sector report the lowest effect. Panel B shows similar results with the added finding that both sales growth and employee growth positively affect changes in working capital accruals. While the magnitude of the coefficients vary across sectors, we find that the coefficient on sales growth is statistically significant for only five sectors (Basic Materials, Industrials, Consumer Goods, Healthcare, and, Technology), while the coefficient on employee growth is statistically significant for four sectors (Consumer Goods, Consumer Services, Telecommunications, and, Utilities). In terms of explanatory power of the models, we find that there is variation in Adjusted-$R^2$ for both the DD and MDD models across the sectors. For the DD model, we find that adjusted-$R^2$ varies from a minimum of 0.168 for the healthcare sector to a maximum of 0.592 for the Telecommunications sector (see, Panel A in Table 5). For the MDD model, adjusted-$R^2$ varies from a minimum of 0.190 for the healthcare sector to a maximum 0.625 for the consumer services sector. But the most important finding that we have is that the explanatory power of the MDD model increases substantially across all sectors when we undertake the regression analysis at the sectoral level. The highest increase in the explanatory power of the MDD model is noted for consumer services sector (Ajusted-$R^2$ for the DD model is 0.242, Adjusted-$R^2$ for the MDD model is 0.625). This reinforces our findings from the preceding analysis.

[10] The ICB code is an industrial classification code that replaced the FTSE and Dow Jones classification system used by stock market participants and investors. The system is used to segregate markets into sectors within the macro economy. We use the code in its highest aggregation and include the following sectors in our analysis: (Oil & Gas # 0001), (Basic Materials # 1000), (Industrials # 2000), (Consumer Goods #3000), (Healthcare # 4000), (Consumer Services # 5000), (Telecommunications # 6000), (Utilities # 7000), (Technology # 9000). We exclude the financial firms (Financials # 8000) from our analysis.

**TABLE 1**

**Descriptive Statistics**

| | | *Mean* | *Std. Dev.* | *25th Percentiles* | *Median* | *75th Percentiles* | *Skewness* | *Kurtosis* |
|---|---|---|---|---|---|---|---|---|
| Working capital accruals | *ACC* | 0.002 | 0.061 | -0.027 | <0.001 | 0.030 | 0.130 | 5.271 |
| Sales Growth Rate | *SG* | 0.132 | 0.271 | <0.001 | 0.079 | 0.199 | 2.883 | 18.250 |
| Employee Growth Rate | *Gem* | 0.079 | 0.240 | -0.034 | 0.033 | 0.128 | 2.820 | 16.897 |
| Cash from operating activities | *CFO* | 0.099 | 0.086 | 0.052 | 0.093 | 0.145 | 0.089 | 4.632 |
| Earnings before long-term accruals | *Earn* | 0.101 | 0.084 | 0.056 | 0.098 | 0.146 | -0.117 | 4.698 |
| Earnings before extraordinary items | *Prof* | 0.052 | 0.087 | 0.023 | 0.055 | 0.093 | -1.602 | 11.119 |
| Accruals | *Accruals* | -0.047 | 0.081 | -0.081 | -0.041 | -0.007 | -0.823 | 9.321 |
| Total assets (in millions) | *TA* | 2300 | 10600 | 45.6 | 169 | 828 | 10.814 | 143.752 |

Sales Growth Rate (*SG*) is the Year-over-year percentage change in sales.

Employee Growth Rate (*Gem*) is defined as Year-over-year percentage change in employee's number.

Working Capital accruals *(ACC)* shows the change in working capital/current accruals and is computed as follows;

$ACC= (\Delta AR + \Delta TInv + \Delta OCA) - (\Delta AP + \Delta ITax + \Delta OCL)$

Where, *ACC* is the current/working capital accruals, *AR* is the total account receivables, *OCA* is the other current assets, *AP* is the accounts payable, ITax is the income tax payable and *OCL* is other current assets. *Δ* is defined as the change in a variable during a year.

*CFO* is the cash from operations.

Consistent with the Dechow and Dichev (2002), we provide earnings before long-term accruals *(Earn)* by adding working capital accruals and cash flow from operations and *(WCC+ CFO).* Earnings before extraordinary items (*Prof)* is item 01551 from Worldscope.

Accruals *(Accruals)* are defined as differences between earnings before extraordinary items (*Prof)* and cash from operating activities (*CFO).*

We scaled all variables by average of total assets (*TA*). All dependent or independent variables are trimmed at the 1st and 99th percentiles, to ensure that outliers do not drive the results.

For all variables, the number of observation is 8,369 firm-year observations.

**TABLE 2**

Pearson and Spearman correlation coefficients between variables base on MDD model

| | ACC | SG | GEm | CFOt-1 | $CFO_t$ | CFOt+1 | Earnt | Earn t+1 | Prof | Accruals t |
|---|---|---|---|---|---|---|---|---|---|---|
| ***ACC*** | | 0.0911 | 0.108 | -0.004 | -0.342 | -0.030 | 0.304 | -0.042 | 0.119 | 0.565 |
| | | *<0.001* | *<0.001* | *0.762* | *<0.001* | *0.030* | *<0.001* | *0.003* | *<0.001* | *<0.001* |
| ***SG*** | 0.067 | | 0.640 | -0.080 | 0.132 | 0.184 | 0.215 | 0.158 | 0.254 | 0.095 |
| | *<0.001* | | *<0.001* | *<0.001* | *<0.001* | *<0.001* | *<0.001* | *<0.001* | *<0.001* | *<0.001* |
| ***GEm*** | 0.064 | 0.625 | | -0.006 | 0.080 | 0.138 | 0.171 | 0.107 | 0.195 | 0.103 |
| | *<0.001* | *<0.001* | | *0.670* | *<0.001* | *<0.001* | *<0.001* | *<0.001* | *<0.001* | *<0.001* |
| ***CFOt-1*** | -0.002 | -0.137 | -0.055 | | 0.589 | 0.515 | 0.591 | 0.519 | 0.467 | -0.192 |
| | *0.883* | *<0.001* | *<0.001* | | *<0.001* | *<0.001* | *<0.001* | *<0.001* | *<0.001* | *<0.001* |
| ***$CFO_t$*** | **-0.382** | 0.051 | 0.011 | 0.573 | | 0.617 | 0.720 | 0.620 | 0.575 | -0.521 |
| | *<0.001* | *<0.001* | *0.435* | *<0.001* | | *<0.001* | *<0.001* | *<0.001* | *<0.001* | *<0.001* |
| ***CFOt+1*** | -0.034 | 0.122 | 0.076 | 0.484 | 0.600 | | 0.605 | 0.708 | 0.505 | -0.186 |
| | *0.015* | *<0.001* | *<0.001* | *<0.001* | *<0.001* | | *<0.001* | *<0.001* | *<0.001* | *<0.001* |
| ***Earnt*** | **0.337** | 0.100 | 0.058 | 0.583 | **0.741** | 0.587 | | 0.602 | 0.690 | -0.131 |
| | *<0.001* | *<0.001* | *<0.001* | *<0.001* | *<0.001* | *<0.001* | | *<0.001* | *<0.001* | *<0.001* |
| ***Earn t+1*** | -0.065 | 0.074 | 0.037 | 0.483 | 0.594 | 0.671 | 0.558 | | 0.547 | -0.166 |
| | *<0.001* | *<0.001* | *0.008* | *<0.001* | *<0.001* | *<0.001* | *<0.001* | | *<0.001* | *<0.001* |
| ***Prof*** | 0.133 | 0.121 | 0.069 | 0.448 | 0.562 | 0.470 | 0.668 | 0.478 | | 0.275 |
| | *<0.001* | *<0.001* | *<0.001* | *<0.001* | *<0.001* | *<0.001* | *<0.001* | *<0.001* | | *<0.001* |
| ***Accruals t*** | 0.548 | 0.076 | 0.063 | -0.126 | -0.456 | -0.131 | -0.067 | -0.116 | 0.480 | |
| | *<0.001* | *<0.001* | *<0.001* | *<0.001* | *<0.001* | *<0.001* | *<0.001* | *<0.001* | *<0.001* | |

In Table 2, Spearman and Pearson correlation coefficients with significances degree are provided above and below diagonal respectively. The sample consists of 8,369 firm-year observations from 2000 to 2013 for 14 years. The p-value of each variable is provided with regards to the coefficient to present the level of significance.
We show their significance levels in *italics*. The upper right triangle data contains *Spearman* coefficients and the lower left triangle contains *Pearson* coefficient. Our study focuses on Pearson (linear correlation).

All variables that are used to run Pearson and Spearman correlation coefficients between variables are trimmed at the 1st and 99th percentiles, to ensure that outliers do not drive the results.

**TABLE 3**

Regression of working capital on past, current and future cash flow from operation for firm- year's observation from 2000 to 2013

*Panel A: Regression result for both Equation (DD) and (MDD)*

| **Variables** | **Equation (DD)** | | **Equation (MDD)** | |
|---|---|---|---|---|
| | Coeff. | t-Statistic | Coeff. | t-Statistic |
| Intercept | 0.015 | 11.700 | 0.011 | 8.640 |
| | | *<0.001* | | *<0.001* |
| $CFO_{t-1}$ | **0.214** | 18.150 | **0.240** | 19.990 |
| | | *<0.001* | | *<0.001* |
| $CFO_t$ | **-0.489** | -41.890 | **-0.497** | -42.750 |
| | | *<0.001* | | *<0.001* |
| $CFO_{t+1}$ | **0.153** | 16.080 | **0.138** | 14.430 |
| | | *<0.001* | | *<0.001* |
| $SG_t$ | | | 0.027 | 7.550 |
| | | | | *<0.001* |
| $Gem_t$ | | | -0.001 | -0.150 |
| | | | | *0.878* |
| *R- squared* | | ***0.253*** | | ***0.266*** |
| *No. observation* | | *5207* | | *5207* |

All variables that are used in the regression for both equations are trimmed at the 1st and 99th percentiles, to ensure that outliers do not drive the results. The significance levels are showed in *italics*.

*Panel: B. Multicollinearity test*

| *Variables (dep.)* | ***Equation (DD)*** | | ***Equation (MDD)*** | |
|---|---|---|---|---|
| | VIF | 1/VIF | VIF | 1/VIF |
| $CFO_{t-1}$ | 2.33 | 0.430 | 2.22 | 0.450 |
| $CFO_t$ | 1.86 | 0.537 | 1.71 | 0.583 |
| $CFO_{t+1}$ | 1.65 | 0.608 | 1.69 | 0.591 |
| $SG_t$ | | | 1.06 | 0.943 |
| $Gem_t$ | | | 1.02 | 0.980 |
| *Mean VIF* | ***1.94*** | | ***1.54*** | |

**TABLE 4**

Fixed and random effects estimation of DD and MDD models

| | ***Equation (DD)*** | | | | ***Equation (MDD)*** | | | |
|---|---|---|---|---|---|---|---|---|
| | **Effects** | | **Hausman test** | | **Effects** | | **Hausman test** | |
| Variables | Fixed | Random | | | Fixed | Random | | |
| | Coeff. | Coeff. | ***Diff. (F-R))*** | ***sqrt**** | Coeff. | Coeff. | ***Diff.*** | ***sqrt**** |
| Intercept | 0.025 | 0.019 | | | 0.022 | 0.015 | | |
| | *<0.001* | *<0.001* | | | *<0.001* | *<0.001* | | |
| $CFO_{t-1}$ | 0.173 | 0.197 | -0.024 | 0.006 | 0.191 | 0.218 | -0.027 | 0.006 |
| | *<0.001* | *<0.001* | | | *<0.001* | *<0.001* | | |
| $CFO_t$ | **-0.520** | **-0.500** | -0.020 | 0.005 | -0.534 | -0.509 | -0.025 | 0.005 |
| | *<0.001* | *<0.001* | | | *<0.001* | *<0.001* | | |
| $CFO_{t+1}$ | 0.119 | 0.138 | -0.019 | 0.005 | 0.106 | 0.126 | -0.020 | 0.005 |
| | *<0.001* | *<0.001* | | | *<0.001* | *<0.001* | | |
| $SG_t$ | | | | | 0.033 | 0.027 | 0.006 | 0.002 |
| | | | | | *<0.001* | *<0.001* | | |
| $Gem_t$ | | | | | -0.002 | -0.002 | <0.001 | 0.002 |
| | | | | | *0.672* | *0.570* | | |
| R-sq: within | **0.29** | **0.288** | | | **0.305** | **0.302** | | |
| between | **0.177** | **0.191** | | | **0.152** | **0.168** | | |
| Overal | **0.241** | **0.251** | | | **0.252** | **0.263** | | |
| *Prob > f* | *<0.001* | *<0.001* | | | *<0.001* | *<0.001* | | |
| *Number of obs* | 5207 | | | | 5207 | | | |
| *Chi2** | | | **23.36** | | | | **39.85** | |
| Prob>chi2 | | | *<0.001* | | | | *<0.001* | |

Note: Hausman test - H0: difference in coefficients not systematic. The number of observation for all equation is 5,207 firm-period observations.

**TABLE 5**

***Panel A:*** *Industry- Specific Regression of Working capital Accruals on Past, Current and Future Cash Flow from Operation for Firms (basd on DD model)*

| *Variables* | **Oil & Gas** | | **Basic Materials** | | **Industrials** | | **Consumer Goods** | | **Healthcare** | | **Consumer Services** | | **Telecommunications** | | **Utilities** | | **Technology** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Coeff.* | *t-stat* | *Coeff.* | *t-stat* | *Coeff.* | *t-stat* | *Coeff.* | *t-stat* | *Coeff.* | *t-stat* | *Coeff.* | *t-stat* | *Coeff.* | *t-stat* | *Coeff.* | *t-stat* | *Coeff.* | *t-stat* |
| *Intercept* | 0.011 | 1.630 | 2.410 | 0.017 | 0.017 | 8.490 | 0.031 | 8.640 | 0.017 | 3.310 | 0.006 | 2.650 | -0.001 | -0.100 | -0.005 | -0.550 | 0.009 | 2.030 |
| | | *0.106* | | *0.002* | | *<0.001* | | *0.028* | | *0.001* | | *0.008* | | *0.919* | | *0.583* | | *0.043* |
| $CFO_{t-1}$ | 0.151 | 2.220 | 0.238 | 5.350 | 0.186 | 9.890 | 0.212 | 6.220 | 0.212 | 3.580 | 0.264 | 10.700 | 0.304 | 4.770 | 0.138 | 1.810 | 0.241 | 6.160 |
| | | *0.028* | | *<0.001* | | *<0.001* | | *<0.001* | | *<0.001* | | *<0.001* | | *<0.001* | | *0.074* | | *<0.001* |
| $CFO_t$ | -0.411 | -6.790 | -0.423 | -10.340 | -0.535 | -28.130 | -0.504 | -14.510 | -0.457 | -7.070 | -0.452 | -18.480 | -0.543 | -9.990 | -0.340 | -4.880 | -0.462 | -12.250 |
| | | *<0.001* | | *<0.001* | | *<0.001* | | *<0.001* | | *<0.001* | | *<0.001* | | *<0.001* | | *<0.001* | | *<0.001* |
| $CFO_{t+1}$ | 0.122 | 2.790 | 0.169 | 5.560 | 0.210 | 13.520 | 0.068 | 2.200 | 0.184 | 3.790 | 0.089 | 4.350 | 0.174 | 3.770 | 0.205 | 3.310 | 0.125 | 4.070 |
| | | *0.006* | | *<0.001* | | *<0.001* | | *0.028* | | *<0.001* | | *<0.001* | | *<0.001* | | *0.001* | | *<0.001* |
| Adjusted R | 0.231 | | 0.317 | | 0.282 | | 0.281 | | 0.168 | | 0.242 | | 0.592 | | 0.208 | | 0.224 | |
| No. obs. | 161 | | 249 | | 2023 | | 638 | | 252 | | 1152 | | 79 | | 112 | | 541 | |

***Panel B:*** *Industry- Specific Regression of working capital Accruals on Past, Current and Future Cash Flow from Operation for Firms (based on MDD model)*

| Variables | **Oil & Gas** | | **Basic Materials** | | **Industrials** | | **Consumer Goods** | | **Healthcare** | | **Consumer Services** | | **Telecommunications** | | **Utilities** | | **Technology** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Coeff.* | *t-stat* | *Coeff.* | *t-stat* | *Coeff.* | *t-stat* | *Coeff.* | *t-stat* | *Coeff.* | *t-stat* | *Coeff.* | *t-stat* | *Coeff.* | *t-stat* | *Coeff.* | *t-stat* | *Coeff.* | *t-stat* |
| *Intercept* | 0.007 | 0.850 | <0.001 | 0.070 | 0.012 | 5.920 | 0.024 | 7.100 | 0.011 | 1.780 | 0.007 | 2.740 | 0.006 | 0.520 | 0.004 | 0.500 | 0.006 | 1.310 |
| | | *0.398* | | *0.945* | | *<0.001* | | *<0.001* | | *0.076* | | *0.006* | | *0.607* | | *0.619* | | *0.191* |
| *SG* | 0.003 | 0.290 | 0.044 | 5.170 | 0.039 | 5.620 | 0.058 | 4.830 | 0.030 | 2.410 | 0.006 | 0.670 | 0.009 | 0.400 | -0.015 | -0.900 | 0.048 | 3.080 |
| | | *0.775* | | *<0.001* | | *<0.001* | | *<0.001* | | *0.017* | | *0.504* | | *0.691* | | *0.368* | | *0.002* |
| *GEm* | 0.023 | 1.610 | 0.009 | 0.770 | <0.001 | <0.001 | 0.042 | 2.800 | -0.006 | -0.420 | -0.016 | -2.040 | -0.049 | -2.010 | -0.055 | -2.050 | -0.011 | -0.710 |
| | | *0.110* | | *0.444* | | *0.998* | | *0.005* | | *0.675* | | *0.041* | | *0.048* | | *0.043* | | *0.481* |
| $CFO_{t-1}$ | 0.168 | 2.360 | 0.348 | 7.650 | 0.222 | 11.620 | 0.245 | 7.550 | 0.239 | 4.010 | 0.263 | 10.220 | 0.285 | 4.300 | 0.158 | 2.150 | 0.268 | 6.790 |
| | | *0.020* | | *<0.001* | | *<0.001* | | *<0.001* | | *<0.001* | | *<0.001* | | *<0.001* | | *0.034* | | *<0.001* |
| $CFO_t$ | -0.424 | -6.960 | -0.445 | -11.570 | -0.544 | -28.960 | -0.510 | -15.450 | -0.449 | -6.990 | -0.455 | -18.240 | -0.548 | -10.380 | -0.392 | -5.730 | -0.486 | -12.780 |
| | | *<0.001* | | *<0.001* | | *<0.001* | | *<0.001* | | *<0.001* | | *<0.001* | | *<0.001* | | *<0.001* | | *<0.001* |
| $CFO_{t+1}$ | 0.120 | 2.690 | 0.117 | 3.970 | 0.190 | 12.290 | 0.045 | 1.540 | 0.171 | 3.520 | 0.094 | 4.540 | 0.173 | 3.820 | 0.189 | 3.160 | 0.109 | 3.570 |
| | | *0.008* | | *<0.001* | | *<0.001* | | *0.124* | | *0.001* | | *<0.001* | | *<0.001* | | *0.002* | | *<0.001* |
| Adjusted R | 0.245 | | 0.411 | | 0.304 | | 0.369 | | 0.190 | | 0.625 | | 0.599 | | 0.286 | | 0.245 | |
| No. obs. | 161 | | 249 | | 2023 | | 638 | | 252 | | 1152 | | 79 | | 112 | | 541 | |

Note: Variables are trimmed at the 1st and 99th percentiles, to ensure that outliers do not drive the results. We run the pooled regression based on the *Industry Classification Benchmark (ICB)*- we include all industries except Financials (8000) as follows: *(Oil & Gas # 0001), (Basic Materials # 1000), (Industrials # 2000), (Consumer Goods #3000), (Healthcare # 4000), (Consumer Services # 5000), (Telecommunications # 6000), (Utilities # 7000), (Financials # 8000), (Technology # 9000).*

P-value of estimated coefficient is provided to illustrate the level of significance. All variables are scaled by average of total assets. The significance level is shown in *italics*. The number of observation for all equation is 5,207 firm-period observations.

## 5. *Conclusion*

Dechow and Dichev (2002) presents a pioneering approach to assessing working capital accruals and earnings quality. In this approach, they define a measure of accruals quality as the standard deviation of the residuals from firm-specific regressions of working capital accruals on past, current, and future cash flows from operations. Despite the widespread use of the DD model in empirical studies, there have been developments in the recent literature, whereby studies have attempted to assess the fundamental assumptions in the DD model. One particular assumption of the DD model, whereby cash flows mapping schedules are the same for both revenue and expense related accruals, is often pointed out to be violated due to omission of important explanatory variables resulting in biased estimates of accruals quality. The ensuing literature has therefore suggested to use a modified DD model of accruals estimation by adding additional explanatory variables to original DD model.

In this paper, we consider the original specification of the Dechow and Dichev (2002) model and compare its performance relative to a modified version of the model as suggested by Bushman *et al* (2011) and Allen *et al* (2013) as a proxy for firms to examine accounting information quality, where accrual quality is defined as the extent to which accruals map into cash flow insights. In this study, we use data on UK listed firms over the period 2000 to 2013, and estimate both the DD and MDD models, whereby we regress working capital accruals on one period lagged, current and one period lead cash flows from operations and other explanatory variables. We compare the performance and explanatory power of both the models by considering differing items of working capital accruals. Our results show that the MDD model is better in explaining variations in working capital accruals than the DD model based on both pooled and fixed effects estimation using our sample of data. We also find that estimating the models at broad sectoral levels reinforce the results from the first part of the analysis. Our findings show that the average UK company behaviour is quite similar to the behaviour found earlier for both models using data from the US.

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